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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/918,115	07/30/2001	Michael Graetzel	16090-23	2594

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EXAMINER
HU, SHOUXIANG

ART UNIT	PAPER NUMBER
2811	

DATE MAILED: 10/09/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/918,115	Applicant(s) GRAETZEL ET AL.	
	Examiner Shouxiang Hu	Art Unit 2811	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *17 June 2002* .

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1 and 4-18* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1 and 4-18* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Claim Rejections - 35 USC § 112

1. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

2. Claims 14-18 are rejected under 35 U.S.C. 112, first paragraph, as based on a disclosure which is not enabling. The subject matter of "layered heterojunction" recited in these claims is critical or essential to the practice of the invention, but is not enabled by the disclosure. See *In re Mayhew*, 527 F.2d 1229, 188 USPQ 356 (CCPA 1976). Newly amended claim 1 defines a heterojunction comprising sensitizing particles between the electron and hole conductors. As shown in Fig. 2, the sensitizing particles (7), the electron conductive particles (6) and the hole conductive particles (8) are mixed together in the interface transition region(s). And, the resulting heterojunction comprises individual point-contact-type heterojunctions, instead of a single layered-type one.

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

4. Claims 1, 4-8, 13-15 and 17, insofar as being in compliance with 35 U.S.C. 112, are rejected under 35 U.S.C. 102(b) as being anticipated by Siebentritt et al. ("Siebentritt"; 14th European Photovoltaic Solar Energy Conference, Barcelona, Spain, 30 June-4 July 1997, pages 1823-1826; of Record).

Siebentritt discloses a solid state sensitized solar cell having a p-n heterojunction (Figs. 1 and 2); comprising: an electron conductor (an n-type semiconductor made of TiO_2, with nanocrystalline and a large band gap); a hole conductor (a p-type semiconductor made of inorganic CuI); a transparent first electrode (SnO_2:F); a second electrode ("metal"); and a CdS sensitizing semiconductor between the electron and hole conductors. It is noted that the CdS sensitizing semiconductor in Siebentritt is inherently in a form consisting of particles adsorbed at the surface of the electron conductor, or that the solid state sensitized solar cell of Siebentritt inherently comprises such a p-n heterojunction with the CdS sensitizing semiconductor inherently in a form consisting of particles adsorbed at the surface of the electron conductor, as Siebentritt further discloses that the chemically deposited CdS sensitizing semiconductor permeates the finer structure of the porous TiO_2 structure (see section 3.3, on page 1826).

Furthermore, it is noted that Siebentritt also discloses that the CdS sensitizing semiconductor is formed through the same method as described in Weller et al. (or, Vogel et al. ("Vogel"; Chemical Physics Letters, V174, N3&4, 9 November 1990, pages 241-246; of record)), with the number of the repeating times of the dipping process including a number as low as 20 (see the upper left column on page 1824 of Siebentritt). And, according to Vogel, the resulting CdS sensitizing semiconductor is in

the form of particles of quantum dots, even with the dipping process being repeated to as high as 30 times (with a quantum-dot particle size of up to 200 Angstroms; see the abstract, section 3, and Fig. 1D in Vogel). Therefore, the resulting CdS sensitizing semiconductor in Siebentritt is inherently in the form of particles of quantum dots.

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

6. Claim 10 is rejected under 35 U.S.C. 103(a) as being obvious over Siebentritt et al. ("Siebentritt"; 14th European Photovoltaic Solar Energy Conference, Barcelona, Spain, 30 June-4 July 1997, pages 1823-1826; of Record) in view of Thelakkat et al. ("Thelakkat"; Synthetic-Metals (Switzerland), Vol. 102, No. 1-3, p. 1125-8, June 1999).

The disclosure of Siebentritt is discussed as applied to claims 1, 4-8, 13-15 and 17 above.

Although Siebentritt does not expressly disclose that the hole conductor can also be made of a polymer, one of ordinary skill in the art would readily recognize that a hole conductor can also be formed of a polymer, as evidenced in Thelakkat (see the hole conductive polymer TPD in Fig. 5); and that in general organic semiconductor materials tend to be mechanically flexible and tend to be made with a simplified process and reduced cost, compared with inorganic one.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to make the solar cell of Siebentritt with the hole conductor being made of a polymer, as taught in Thelakkat, so that a solar cell with improved flexibility, simplified process and/or reduced cost would be achieved.

7. Claims 9, 11 and 12 are rejected under 35 U.S.C. 103(a) as being obvious over Siebentritt et al. ("Siebentritt"; 14th European Photovoltaic Solar Energy Conference, Barcelona, Spain, 30 June-4 July 1997, pages 1823-1826; of Record) in view of Bach et al ("Bach"; Nature, V395, 8 October 1998, pages 583,585; of record).

The disclosure of Siebentritt is discussed as applied to claims 1, 4-8, 13-15 and 17 above.

Although Siebentritt does not expressly disclose that the hole conductor can also be made of an organic OMeTAD, one of ordinary skill in the art would readily recognize that organic OMeTAD is an art-recognized hole conductor for solar cells, as evidenced in Bach (see the abstract); and that in general organic semiconductor materials tend to be mechanically flexible and tend to be made with a simplified process and reduced cost, compared with inorganic one.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to make the solar cell of Siebentritt with the hole conductor being made of an organic OMeTAD, as taught in Bach, so that a solar cell with improved flexibility, simplified process and/or reduced cost would be achieved.

8. Claim 16, insofar as being in compliance with 35 U.S.C. 112, is rejected under 35 U.S.C. 103(a) as being obvious over Siebentritt et al. ("Siebentritt"; 14th European Photovoltaic Solar Energy Conference, Barcelona, Spain, 30 June-4 July 1997, pages 1823-1826; of Record) in view of Kay et al. ("Kay"; 5,525,440).

The disclosure of Siebentritt is discussed as applied to claims 1, 4-8, 13-15 and 17 above.

Although Siebentritt does not expressly disclose that the cell can further comprise a dense semiconductor layer between the first electrode and the heterojunction, Kay teaches to form a photo cell (Fig. 1) comprising a dense semiconductor layer (3; a non-porous TiO_2) between a first electrode (2A) and the cell junction portion (4-6) for providing a desired diffusion barrier therebetween.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate the dense semiconductor layer of Kay into the solid state sensitized photovoltaic cell of Siebentritt, so that a photovoltaic cell with a desired diffusion barrier would be obtained.

9. Claim 18, insofar as being in compliance with 35 U.S.C. 112, is rejected under 35 U.S.C. 103(a) as being obvious over Siebentritt et al. ("Siebentritt"; 14th European Photovoltaic Solar Energy Conference, Barcelona, Spain, 30 June-4 July 1997, pages 1823-1826; of Record) in view of Vogel et al. ("Vogel"; Chemical Physics Letters, V174, N3&4, 9 November 1990, pages 241-246; of record).

The disclosure of Siebentritt is discussed as applied to claims 1, 4-8, 13-15 and 17 above.

Although Siebentritt does not expressly disclose that the deposition treatment for the quantum dot particles can be performed 2-10 times, Vogel teaches that sensitizing particles with deposition treatment (dipping process) performed 5 or 10 times have very small size and lead to higher incident photon to current efficiency (IPCE), compared to the one with higher dipping-process repeating times (see Figs. 1-4).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to make the solar cell of Siebentritt with the deposition treatment for the sensitizing particles being performed 5 or 10 times, per the teachings of Vogel, so that a solar cell with high IPCE would be achieved.

Response to Arguments

10. Applicant's arguments filed on June 17, 2002 have been fully considered but they are not persuasive.

Applicant's main arguments include: (A) The CdS material in Siebentritt is not in the form of separated particles, while the recited "particles" in the claimed invention of the instant invention has the meaning of "separated particles"; (B) The CdS material portions in Siebentritt are aggregated so as to form more or less continuous coating films; (C) It is not obvious to incorporate the teachings of Vogel into the solid state heterojunction of Siebentritt to obtain the claimed invention, because Siebentritt teaches to repeat the dipping process 20 to 40 times, and Vogel fails to disclose or suggest the

use of CdS particles for making a solid state heterojunction; (D) Bach fails to teach that the sensitizing semiconductor can be formed of inorganic separated quantum dot particles and that OMETAD can also achieve high IPCE with an inorganic sensitizing particles; and (E) Kay fails to teach a solid state heterojunction with separated sensitizing particles.

In response to above Arguments A, B, D and E, it is noted that the term of "a form of particles adsorbed at the surface of said electron conductor" as recited in claim 1 of the instant application does not necessarily have the meaning that the particles are separated, as one can describe a group of particles as in a form of particles adsorbed at a surface even thought the particles may be in contact to each other. Accordingly, the features of separated particles upon which applicant relies are regarded as not being recited or inherent in the rejected claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993).

Furthermore, regarding above Arguments A-C, as noted in the claim rejections set forth above in this office action, the solar cell of Siebentritt inherently comprises a CdS sensitizing semiconductor in a form consisting of particles adsorbed at the surface of the electron conductor, as Siebentritt discloses that the TiO_2 electron conductor has a structure with nanoporous (see section 1 on page 1823), that in the solar cell (note: after the annealing at 125 ^{0}C; see the upper left column on page 1824) no element contrast can be found within the TiO_2/CdS layer (note: not layers), as the chemically deposited CdS sensitizing semiconductor has permeated the finer structure of the

porous TiO_2 structure (see section 3.3, on page 1826). Moreover, Siebentritt also discloses that the CdS sensitizing semiconductor is formed through the same method as the one described in Weller et al. (or, Vogel), with the number of the repeating times of the dipping process including a number as low as 20. And, according to Vogel, CdS sensitizing semiconductor formed with such a method is in the form of particles of quantum dots, even with the dipping process being repeated to as high as 30 times. Therefore, the resulting CdS sensitizing semiconductor in Siebentritt is inherently in the form of quantum-dot particles.

Moreover, with respect to Arguments C-D, it is noted that one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.,* 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986). And, in response to applicant's arguments that there is no suggestion to combine the references, the examiner recognizes that obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988) and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). In this case, the solar cell in Siebentritt is a solid state one that inherently comprises solid state quantum-dot-sized sensitizing particles adsorbed on the surface of the electron conductor. And, Siebentritt further teaches to incorporated the sensitizing-particles-forming method of Vogel into

the solid state solar cell to form the CdS sensitizing material permeating the finer structure of the porous TiO_2. Vogel is further cited in the above claim(s) rejection for showing that one of ordinary skill in the art would readily recognize the desirable dipping-process with 5 or 10 repetitions for forming finer particle size and achieving better IPCE, regardless what material is for the hole conductor.

Bach is cited in the above claim rejection(s) for showing that one of ordinary skill in the art would readily recognize that organic OMeTAD is an art-recognized P-type semiconductor which can always form a PN heterojunction with an N-type semiconductor of other type; and that, compared with inorganic semiconductor materials, organic semiconductor materials generally tend to be mechanically flexible and tend to be made with a simplified process and reduced cost, regardless what material the sensitizing semiconductor is made of.

And, Kay is cited in the above claim rejection(s) for showing that one of ordinary skill in the art would readily recognize the advantages of providing a desired diffusion barrier with a dense semiconductor layer between a first electrode and the junction portion in a photo cell, regardless what material or structure is for the sensitizing semiconductor.

Applicant's other arguments with respect to claims 1 and 4-18 have been considered but are moot in view of the relevant new ground(s) of rejection.

Conclusion

11. Applicant's amendment necessitated the relevant new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

12. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Shouxiang Hu whose telephone number is (703) 306-5729. The examiner can normally be reached on Monday through Thursday, 7:30 AM to 6:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tom Thomas can be reached on (703) 308-2772. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9318 for regular communications and (703) 872-9319 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

SH
October 4, 2002